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Check our Learn section!
AGENDA:

Shabtai ISAAC, Associate Professor, BGU:
Benefits and barriers for the practical implementation of Net Zero Energy Settlements

Margarita-Niki ASSIMAKOPOULOS, Associate Professor, NKUA:
The ZERO-PLUS approach for the design, construction and monitoring of Net Zero Energy Settlements (NZES): What it is, what are the benefits, what can it achieve, where is it applicable.

Kostas GOBAKIS, Research Associate, TUC:
The digital monitoring and evaluation platform of ZERO-PLUS. The way towards a digitalized future

Anna Laura PISELLO, Assistant Professor, UNIPG:
Energy communities. How have regulations/market changed the past years and what is still needed. The case of the Italian ZERO-PLUS settlement

Salvatore CARLUCCI, Professor, CYI:
Technologies for the settlements of the future. The case of the Cipriot ZERO-PLUS case study

Sven KOEHLER, Executive Director, ANERDGY:
Benefits for the technology provider. Opportunities for TRL advancement and SME growth from participation in H2020 Innovation Actions

Moderated Q&A.
Benefits and barriers for the practical implementation of Net Zero Energy Settlements

Dr. Shabtai Isaac
Department of Structural Engineering
Ben Gurion University of the Negev
Israel
Isaacsh@bgu.ac.il
2010 EPBD

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 19 May 2010

on the energy performance of buildings

(recast)

Article 9

Nearly zero-energy buildings

1. Member States shall ensure that:

(a) by 31 December 2020, all new buildings are nearly zero-energy buildings; and

(b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.

Member States shall draw up national plans for increasing the number of nearly zero-energy buildings. These national plans may include targets differentiated according to the category of building.
NZE Buildings

In ZERO-PLUS:
0-20 kWh/m² per year
Cost of NZE Buildings

NZE Buildings are expensive to build

Graphic: SERA Architects/GBD Architects
The concept of NZE Settlements
Benefits of NZE Settlements

• Economies of scale
• Access to expertise
• Additional energy technologies feasible
• Improved urban planning (reduce heat island)
• Modular building technologies – faster and cheaper
Challenges in realizing NZE Settlements

• Increased technological complexity
• Numerous stakeholders involved
• Longer and more complex design process
• Need for novel tools and methods to support design and construction
Acknowledgment: This project has received funding from the European Union’s H2020 research and innovation programme under grant agreement N° 678407
The **ZERO-PLUS approach** for the design, construction and monitoring of Net Zero Energy Settlements (NZES): What is it, What are the benefits, What can it achieve, Where is it applicable

Build Up webinar
19 November 2020

Dr M.N. Assimakopulous
Group Building Environmental Studies, Physics Department, NKUA, Greece
Definition of the concept of Nearly Zero-Energy Building (NZEB) in EPBD Article 2(2): “a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby”.

The district is “the optimal scale to accelerate sustainability - small enough to innovate quickly and big enough to have a meaningful impact.” (EcoDistricts, 2013)
What is the ZERO-PLUS approach

ZERO-PLUS is a comprehensive, cost-effective approach for the design, construction and monitoring of Net Zero Energy Settlements (NZES). Focusing on the settlement-level instead of on single buildings, the ZERO-PLUS approach aims to bring together settlement planners, building designers, technology developers and suppliers, energy efficiency and renewable energy experts, contractors, and building owners who work together from the earliest stages of project conception to optimise the NZES design.

Learn more about the developed **Tools and Methods** for each phase in this Guidebook:
What are the benefits

- Increased efficiency through the application of communal energy production and management technologies
- Improved microclimate conditions through urban design solutions, leading to a reduction in energy demand and CO\textsubscript{2} emissions
- Optimal energy production through a proper technology design and integration at settlement scale
- Economies of scale, leading to opportunities for lower initial investment costs
- Selection of cost-optimal combination and size of technologies
- Access to the expertise required for the design, construction and maintenance of innovative building and settlement design solutions
- Enhanced building performance for the end users
What can it achieve

Application of the ZERO-PLUS approach ensures achievement of **cost, energy use** and **renewable energy production** targets. The targets to be achieved can be adjusted as needed for specific cases.

In the ZERO-PLUS project the targets were:

- Net regulated energy: 20 kWh/m²/y
- RES production: 50 kWh/m²/y
- Cost reduction: 16%

<table>
<thead>
<tr>
<th>Country</th>
<th>Net Regulated energy (KWh/m²/year)</th>
<th>Renewable energy production (KWh/m²/year)</th>
<th>Cost reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT</td>
<td>-11.0</td>
<td>47.6</td>
<td>24.8%</td>
</tr>
<tr>
<td>FR</td>
<td>-10.1</td>
<td>123.0</td>
<td>26.7%</td>
</tr>
<tr>
<td>UK</td>
<td>-1.0</td>
<td>51.2</td>
<td>17.8%</td>
</tr>
<tr>
<td>CY</td>
<td>18.9</td>
<td>54.3</td>
<td>17.0%</td>
</tr>
</tbody>
</table>
Where is it applicable

The ZERO-PLUS approach has been developed primarily for **new settlements and neighborhoods** but it can also:

- be adjusted so that it is also applicable for the **retrofit of existing settlements**.
- easily be expanded to include **additional uses** (e.g. schools, office buildings, etc.).
  - In fact, such an expansion is likely to make the approach even more effective given the larger scale of many such buildings, and the fact that they are often located within campuses in which settlement-level solutions could be more easily applied.

The approach is also relevant for **different building types** – both public and private housing, single and multi-unit housing - and is also applicable in a range of **different climatic regions** with different heating and cooling requirements.

- **Voreppe, France**
  - Semi-continental climate
  - Social housing apartment block

- **Granarolo dell’Emilia, Italy**
  - Temperate and Mediterranean climate
  - Villas

- **York, UK**
  - Temperate climate
  - Detached and semi-detached dwellings

- **Nicosia, Cyprus**
  - Intense Mediterranean climate
  - Prefabricated container system
Thank you very much for your attention

Dr. M. N. Assimakopoulos
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masim@phys.uoa.gr

Follow us on:
www.zeroplus.org
zeroplusproject
@zeroplus_eu
The digital monitoring and evaluation platform of ZERO-PLUS. The way towards a digitalized future

Dr Kostas Gompakis
Research Associate
Technical University of Crete

Designing, constructing and monitoring Net Zero Energy (NZE) Settlements, 19/11/2020
Web-GIS Platform for Monitoring of ZERO PLUS

Design and Construction of 4 Zero Energy Settlements

York, UK
3 houses
- PV panels
- Hive smart thermostat
- TESLA battery

Voreppe, France
Apartment building
- DUALSUN solar panels, thermal and photovoltaic
- ANERDGY MRE C05
- Heat exchanger of the biomass urban heating network

Granarolo dell’ Emilia
2 villas
- Fibran insulation
- PV panels
- ABB React+

Nicosia, Cyprus
Prefabricated demo house
- Fibran insulation
- HVAC FREESCOO
- FAE HCPV
A Web-GIS platform has been created in order to:

- **To support effective monitoring** of the case studies and **collect all energy and environmental data** regarding the performance of the four settlements.

- **To assess the performance** of the involved systems and technologies and also the global energy and environmental performance of the settlements.

- **To implement an optimised maintenance methodology** for all systems and techniques in order to achieve the best possible performance and cost effective operation.

- **To analyse** in depth the results of the monitoring and generate proper technical information for future feasibility analyses and design.
Web-GIS Platform for Monitoring of ZERO PLUS

OVERALL PLATFORM LAYOUT

Web GIS platform

Database

Intelligent models

KPI calculations

End User

Measuring Devices

Measuring Devices

Measuring Devices

Measuring Devices
Data sources for the four case studies

- Italy
  - IEQ (T, RH, CO₂), energy consumption (KNX IP router)
  - Heating/cooling set Point (HVAC controller, Rotex G1)
  - PV energy production and battery storage (ABB Aurora Vision)
  - Outside meteorological conditions (Vantage Pro2™ Plus with 24-Hr Fan Aspirated Radiation Shield)

- France
  - IEQ (T, RH, CO₂), energy consumption, energy production (PV, hot water) (Backnet IP router)
  - Outside meteorological conditions (Vantage Pro2™ Plus with 24-Hr Fan Aspirated Radiation Shield)

- UK
  - IEQ (T, RH, CO₂), energy consumption (Orsisenergize)
  - T, heating set point (Hive)
  - Energy production and battery storage (Telsa Power Wall)
  - Outside meteorological conditions (Vantage Pro2™ Plus with 24-Hr Fan Aspirated Radiation Shield)

- Cyprus
  - IEQ (T, RH CO₂), energy consumption (BacknetIP router)
  - Energy production (electrical, hot water), Heating/cooling set point, HVAC consumption (Frescoo and FAE industrial controller/Modbus)
  - Outside meteorological conditions (Vantage Pro2™ Plus with 24-Hr Fan Aspirated Radiation Shield)
Web-GIS Platform for Monitoring of ZERO PLUS

Topology I
- Settlement
- Sensors
- Modbus TCP
- REST API over https
- Web GIS platform

Topology II
- Sensors
- Monitoring Device/router
- Manufacturer platform
- REST API over https
- Web GIS platform

Topology III
- Settlement
- Sensors
- VPN network
- Web GIS platform
Measurements gathering
Web-GIS platform walkthrough

ZeroPlus WebGis Platform

User Name:

Password:

Login

Test account:

1) researcher: researcher
Web-GIS platform walkthrough
### Italian settlement, Novafeltria

<table>
<thead>
<tr>
<th>General information</th>
<th>Detailed information</th>
<th>Key Performance Indicators</th>
<th>Historical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>Italy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region</td>
<td>Novafeltria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net floor area</td>
<td>4000m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of buildings</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RES</td>
<td>Wind Rail, SBSkin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The demonstration case study belonging to the Italian NZE settlement of Novafeltria (RN) is represented by four residential single-family villas, i.e. ground floor buildings. Each villa can host an average of 3 people, with a maximum of 5 people. The main geometrical and dimensional characteristics of the settlement and the standard villa are listed below. Total lot area of the settlement: about 30,150 m² (including public spaces) Total lot area dedicated to the demonstration case study: about 2500 m², with 1600 m² occupied by the total lot area of the all villas and the remaining area by the private street Lot area of each villa: about 400 m², with 130 m² occupied by the building and the remaining area by the private garden Total net floor area: about 100 m², with 80 m² of residential net floor area (i.e. excluding the private garage)
Web-GIS platform walkthrough

Case Study: Novafetria, Italy

General information  Detailed information  Key Performance Indicators  Historical data

Energy Production  Energy Consumption  Indoor Environmental Quality

Settlement  Building

Settlement Energy Production

Settlement total energy production

localhost/03CesiumHighChart/public_html/map.php#tabsGl:2
Web-GIS platform walkthrough

Case Study: Novafetria, Italy

General information  Detailed information  Key Performance Indicators  Historical data

Measurement: Settlement buildings electric power

Zoom: 1m 3m 6m YTD All From: 29/09/2016 To: 29/12/2016

Print chart
Download PNG image
Download JPEG image
Download PDF document
Download SVG vector image
Download CSV
Download XLS
View data table

Outdoor air temperature  Settlement buildings electric power
Web-GIS platform walkthrough

Building level

General information
- Building type: Residential
- Building name: Vila1A, Vila1A
- Building stories: 2
- Area: 300m²
- RES: WindFall SB

Energy consumption: 113,439.12 kWh
Energy production: 113,808.58 kWh

General Data
- Building electric consumption
- Building electric production

Settlement Information: 12.38068, 43.0222
Web-GIS platform walkthrough

Building level

General  Energy  Indoor Environmental Quality  Historical data

General  Consumption  Production

Electric Equipment

Light

HVAC

Electric Equipment

Space equipment electric power  Space light electric power  Space HVAC electric power
Web-GIS platform walkthrough
Monthly report No X for: villa2, Settlement: Italy
From 01/11/2019 to 01/12/2019 generated on 01/04/2020 12:07:02

Indoor Environmental Quality

<table>
<thead>
<tr>
<th></th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
<th>CO₂ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>21.71</td>
<td>52.55</td>
<td>548.20</td>
</tr>
<tr>
<td>Maximum</td>
<td>24.54</td>
<td>65.07</td>
<td>1209.60</td>
</tr>
<tr>
<td>Minimum</td>
<td>20.09</td>
<td>21.82</td>
<td>390.08</td>
</tr>
<tr>
<td>Lost Measurements (%)</td>
<td>0.38</td>
<td>0.38</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Energy Consumption

Building HVAC (kWh)

<table>
<thead>
<tr>
<th></th>
<th>November</th>
<th>November -1Y</th>
<th>October</th>
<th>Expected from Simulation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>495.96</td>
<td>0.00</td>
<td>135.88</td>
<td>271.99</td>
<td>223.97</td>
</tr>
<tr>
<td>Average energy workday</td>
<td>16.58</td>
<td>0.00</td>
<td>4.67</td>
<td>5.06</td>
<td>7.52</td>
</tr>
<tr>
<td>Average energy weekend</td>
<td>16.42</td>
<td>0.00</td>
<td>3.38</td>
<td>9.09</td>
<td>7.33</td>
</tr>
<tr>
<td>Lost Measurements</td>
<td>0.35</td>
<td>100.00</td>
<td>8.40</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Building domestic hot water consumption (kWh)

<table>
<thead>
<tr>
<th></th>
<th>November</th>
<th>November -1Y</th>
<th>October</th>
<th>Expected from Simulation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total energy</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>155.94</td>
<td>-155.94</td>
</tr>
<tr>
<td>Average energy workday</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>5.25</td>
<td>-5.25</td>
</tr>
<tr>
<td>Average energy weekend</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>5.07</td>
<td>-5.07</td>
</tr>
<tr>
<td>Lost Measurements</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Thank you very much for your attention

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Energy communities. How have regulations/market changed the past years and what is still needed. The case of the Italian ZERO-PLUS settlement

Anna Laura Pisello, Ph.D.
CIRIAF – Interuniversity Research Centre, Department of Engineering, University of Perugia, Italy

www.eaplab.eu
I. Premises

II. European Legislation

III. Italian ZERO-PLUS settlement

IV. Italian Legislation

V. Market Transition

VI. What is still needed

Energy communities. How have regulations/market changed the past years and what is still needed. The case of the Italian ZERO-PLUS settlement

Anna Laura Pisello, Ph.D.
...about Energy Communities

The future energy system aims at being

• green
• efficient
• decentralized
• democratic

towards sustainable economy and climate neutrality.

Energy communities are novel legal, technical, and social entities that involve citizens’ participation in the energy system as prosumers with the main goal to provide environmental, economic, and social benefits for the community rather than profit making.
Energy communities. How have regulations/market changed the past years and what is still needed. The case of the Italian ZERO-PLUS settlement

November 19th, 2020

Anna Laura Pisello, Ph.D.

EUROPEAN REGULATORY FRAMEWORK

- **Clean Energy for All Europeans Package (CEP)**
Energy communities. How have regulations/market changed the past years and what is still needed. The case of the Italian ZERO-PLUS settlement

November 19th, 2020

Anna Laura Pisello, Ph.D.
THE CLEAN ENERGY PACKAGE FORMALIZING NEW FORMS OF ACTIVE CONSUMERS

- **Self Consumption**
  - *Individual Self Consumption* is already prevalent across Europe
  - *Collective Self Consumption* or energy sharing draw increasing interest

- **Energy Communities**
  - Legal entity created by citizens, SMES, local authorities, etc.
  - Controlled by its members
  - Not primarily focused on financial profits
  - Providing social, environmental, economic benefits to its member and stakeholders
  - Entitled to operate on a level playing field with commercial actors
CLEAN ENERGY FOR ALL EUROPEANS PACKAGE

Electricity Market Directive 2019/944/UE (EMD): Active consumer (can be a group of jointly acting final customers)
- Who consume or store electricity generated within their premises located within confined boundaries (can be extended by MS)
- Who sell self-generated electricity

EMD: Citizen Energy Community (CEC)

- Who are located in the same building or multi-apartment block
- Who generate renewable electricity for their own consumption
- Who may store or sell self-generated renewable electricity

RED: Renewable Energy Community (REC)
Citizen Energy Community (CEC)

- Supply, consumption, storage, aggregation and distribution of electricity, other energy services
- No explicit geographical limitation
- Citizens, SME, public authorities, effectively controlled by members or shareholders
- Aim to create a level playing field for communities
- Member State may allow Citizen Energy Community (CEC) to have distribution system operator (DSO) status-
  Possibility to give them the advantages of “closed networks”

Renewable Energy Community (REC)

- Production, consumption, storage and selling of renewable energy
- Members to be located “in proximity” of community renewable energy projects
- Exclusively citizens, SMEs or local authorities, effectively controlled by local members or shareholders
- Instrument to promote and facilitate the development of RE-
  Elimination of barriers
- Grids excluded from RECs
Residential NZE Settlement
GRANAROLO DELL’EMILIA, ITALY

- **Warm and humid temperate climate**
- **4 to 2 single-family buildings**
- **Energy conservation, production and management technologies:**
  - High-performance FIBRAN XPS for the external building envelope;
  - High efficiency **Air-water heat pump** and CMV with heat recovery;
  - **Load control** and energy management in each building
  - **12 kWp PV panels** within the settlement and building energy storage
  - **Cool materials** for external envelope and outdoor paving in the settlement
  - **Greenery** in outdoor areas of the settlement for microclimate mitigation
...barriers and challenges

- **Big policy barriers** on a legal basis for the implementation of community contracts

- **Targeted analysis of users acceptance**

- **Technical barriers:**
  - Easy technologies, except for RES that require environmental/other permissions on the outdoors
  - Operation and maintenance of the shared systems: privacy and intrusion
ITALIAN REGULATORY FRAMEWORK

- MILLEPROROGHE DECREE (D.L. DECEMBER 2019, N. 162)
- CONVERSION DECREE INTO LAW FEBRUARY 28TH, 2020, N. 8
- RESOLUTION ARERA 318/2020/R/EEL AUGUST 4TH, 2020
- D.M. MISE SEPTEMBER 15TH, 2020
Italy is introducing the concept of **Renewable Energy Communities (REC)**: groups of citizens, retail businesses and other companies that decide to join forces to equip themselves with systems to **produce** and share energy from **renewable sources**.
MILLEPROROGHE DECREE (D.L. DECEMBER 2019, N. 162)

- Citizens’ associations, chain stores or companies with offices in the same building can **invest in a shared system** with an overall power output of up to **200 kW**;
- they **share the energy** produced either by consuming it immediately or by **storing** it in storage systems for use when required;
- the system must be connected to the low-voltage network, through the same MV/LV transformer substation from which the energy community receives power from the grid;
- Energy Communities has their **legal status** which define the rights of their individual participants;
- participants will still be free to choose their electricity provider and can name a delegate, including someone belonging to an external company, to manage flows with the GSE (Gestore dei Servizi Energetici, the State-controlled Energy Services Operator);
the law identifies the GSE as the operator enabled to pay the **incentivizing tariffs** it provides for, for electricity produced by Renewable Energy Communities.

**RESOLUTION 318/2020/R/EEL ON AUGUST 4<sup>TH</sup> 2020 BY ARERA**
(regulatory authority for energy, network and the environment)

Established the requirements for **access to incentives** and **calculation models** to determine the fees to be paid by the GSE to self-consumers who act collectively and to members of energy communities.
The MiSe established the characteristics of the incentive, i.e. tariff contribution varies in function of the transmission and distribution components of the shared energy.

**COLLECTIVE SELF CONSUMPTION:** 100 euros for each MWh of shared energy

**ENERGY COMMUNITY:** 110 euros for renewable energy communities

**THESE INCENTIVES ARE RECOGNIZED FOR A PERIOD OF 20 YEARS**

Calculation models – still work in progress
How is the market changing?

- **Prioritize community benefits rather than profit making**
- **Active involvement and cooperation of citizens in the energy system**
- **Consumer empowerment → Prosumer**
  - Mobilizing private capital
  - Increase flexibility in the electricity system
- **Collective self-consumption**
- **Shared energy incentive schemes**
ENERGY TRANSITION TO A DECENTRALIZED, RENEWABLE, EFFICIENT, AND SUSTAINABLE ENERGY SYSTEM WITH CITIZENS AT ITS CORE STILL NEEDS

- **Shared and acknowledged policy** at national and – most of all – EU level
  - Regulatory models to be applied to these new subjects

- *Ad hoc* business and technical models
  - Transitions among prosumers
  - Transitions among energy communities

- Right mix of **incentives** for all stakeholders (not only bottom-up but also top-down)

- Enable and mobilize interest and **trust** among communities
THANK YOU FOR YOUR KIND ATTENTION

Anna Laura Pisello, Ph.D.

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anna.pisello@unipg.it

This project has received funding from the European Union’s H2020 research and innovation programme under grant agreement Nº 678407.

www.eaplab.eu
THE ZERO-PLUS PROJECT: DESIGNING, CONSTRUCTING AND MONITORING NET ZERO ENERGY SETTLEMENTS

Technologies for the settlements of the future: The Cyprus case study

Prof. Salvatore Carlucci

19th November 2020
Which future for the building sector?
Which future for the building sector?

LOCAL CLIMATE CHANGE
- Responsible for about 38% of GHG emissions

ENERGY AND RESOURCE CONSUMPTION
- Liable for about 30-50% of final energy and material use

OLD AND LOW QUALITY
- 49% of stock built before 90' without proper insulation

URBAN VULNERABILITY
- Cities host 54% of world's population
- Exposed to natural and man-made hazards

URBAN HEAT ISLAND
- UHI intensity exceeds 5 °C in intensive urbanizations

ENERGY POVERTY
- 200 M people cannot afford energy bills

LOCAL CLIMATE CHANGE
- Responsible for about 38% of GHG emissions

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- Liable for about 30-50% of final energy and material use

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URBAN VULNERABILITY
- Cities host 54% of world's population
- Exposed to natural and man-made hazards

ENERGY POVERTY
- 200 M people cannot afford energy bills
Which future for the building sector?

- Zero-energy
- Sustainable
- Health and comfort
- Energy flexibility
- Economical to build and maintainance
Technologies for the settlements of the future

Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology: to search for buildings design for new highly energy performing buildings and settlements. The ambition is to develop a comprehensive, cost-effective modular system for Net Zero Energy (NZE) settlements in a series of case studies across the EU. The ZERO-PLUS project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N° 678407.

Smart Grid Energy Management: to fully analyze all aspects of smart grids targeting in the improvement of reliability, mitigation of security risks, increase load shaping and energy efficiency, optimal integration and generation-consumption matching as well as smart monitoring and control. To this end, the aim of the SMART GEMS project is to use Smart Grids’ optimization and reliable operation concept as the common basis for collaboration and staff exchange among the partners. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N° 645677.

nature-inspired Modular and flExible Skin for High Efficiency buildings: to develop a totally innovative façade system, which combines cost-effectiveness, high adaptability, multifunctionality. MESH applies parametric, nature-inspired design approaches, emerging smart materials and digital fabrication strategies, to offer locally distributed production of building skin adapted to the architecture of intervention. Funded by the Cyprus RIF Pre-SEED programme.

The sole responsibility for the content of this presentation lies with the authors and does not necessarily represent the opinion of the European Union.
The ZERO-PLUS case study @ the Cyprus Institute
freescoo
an innovative Desiccant and Evaporative Cooling technology
Freescoo (Free Solar Cooling)
An air-conditioning device fed by low-grade solar thermal energy

Freescoo is an air-conditioning device based on an innovative DEC technology (*Desiccant and Evaporative Cooling*). It offers:

- Air change
- Dehumidification
- Space cooling
- Space heating
- Heat recovery
Freescoo (Free Solar Cooling)
An air-conditioning device fed by low-grade solar thermal energy

Freescoo is an air-conditioning device based on an innovative DEC technology (Desiccant and Evaporative Cooling). It offers:

- **Air change**
- **Dehumidification**
- **Space cooling**
- **Space heating**
- **Heat recovery**

- **High global electrical efficiency** (Typical EER > 10 in comparison to standard vapor compression HVAC EER = 2,5-5)
- **Energy savings** and **CO₂ emission reduction** (up to 80%) if fed by renewable heat
- **Favorable coupling** with multifunctional HP and better exploitation of solar thermal energy and waste heat
- **Possible free-cooling** operation as indirect evaporative cooler and heat recovery
- **High indoor air quality**: Thanks to the combination of air filtration and adsorption mechanisms, freescoo provides clean and fresh air
- **No use of dangerous substances and aggressive fluids** harmful for the environment and does not require precautions in production and maintenance
- **Preassembled** and **ready for installation**; high **system configuration customization**
- Freescoo is a **patented solution** by the startup company SOLARINVENT
Freescoo
First prototypes developed in the framework of research projects

System installed for testing purposes in 2014 at the University of Palermo, Italy

System installed for testing purposes in 2014 at the ENEA Casaccia

Demo system installed in the library of the AMEE research center in Marrakech, Morocco, November 2016
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Drawbacks
- Limited capacity in terms of regeneration heat production and dehumidification rate
- High weight
- Positioning on a terrace or roof required
Freescoo
Fostering building integration with a façade module
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Fostering building integration with a façade module
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Fostering building integration with a façade module

In the framework of the EU ZERO-PLUS Project, the system design has been optimized:
- Integration in the building facade
- Separation between the solar field and the HVAC unit
- Vertical configuration of the unit in order to make a positioning on the wall possible, limiting the footprint
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Freescoo

Fostering building integration with a façade module

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Data specifications
- Air flow rate 500 m³/h
- Cooling power 2 kW
- Required heat at 60-65°C
- Water consumption about 2 l/kWh of cooling energy
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Freescoo
Heat recovery ventilation (HRV) for residential and office buildings

Data specifications

- **Vertical configuration**, air duct connections on top of the unit
- Air flow rate 400 m$^3$/h
- Cooling power 4 kW
- Required heat at 65°C
- **High dehumidification rate** (up to 10 g/kg)
- **100% fresh air to the building**
- Favorable coupling with multifunctional heat pumps operating at high temperature (i.e. for DHW): the condensation heat rejected by the HP can be used to drive the freescoo HRV unit
HCPV/T system
High Concentration Photovoltaic and Thermal system
HCPV/T FAE
Primary and secondary optic

• Solar light is concentrated by double curvature parabolic mirrors (45x45 cm) into a secondary optic.

• Solar beams are focused from an area of 0.2 m² to 1 cm² with a concentration factor of 2 000 suns.

• Optical losses in reflective and refractive transmissions are reduced using:
  • Solar glass with silver (Ag) reflective coating
  • Pure glass materials for secondary optic light pipe
  • High transmission glues for optical connection between components
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The new generations of multi-junction solar cells convert 46% of the solar light into electric power.
HCPV/T FAE
Active cooling system

- Designed with the support of CFD,
- The geometry of the heat sink allows to keep the cell at a high level of electrical efficiency ($\eta_{el} > 30\%$),
- while bringing the heat transfer fluid (water) up to an output temperature of 70-80°C, suitable for civil and industrial low-temperature applications.
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HCPV/T
Tracking system and module configuration

2-axis **sun tracker** is used for a module composed by:
- 20 solar cells
- 20 primary and secondary optic

The HCPV/T system’s performance is:
- Electrical peak power generation $\approx 1 \text{kW}_{\text{el, peak}}$
- Thermal peak power generation $\approx 2 \text{kW}_{\text{th, peak}}$
- Outlet water temperature $\approx 70^\circ\text{C}$
- CHP efficiency of 72 to 85%
- Electrical efficiency ranging from 27 to 30%
- Thermal efficiency of about 45 to 55% within the temperature of 40-70°C of the heat transfer fluid
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North - South orientation
HCPV/T
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HCPV/T
Installation in the pilot at The Cyprus Institute
HCPV/T
Installation in the pilot at The Cyprus Institute

- The HCPV/T is connected to a battery array though and inverter, which allows the system to store electricity that can be used when electricity generation is absent or reduced.
- The battery array can also be used to shave the peaks of electricity demand increasing energy flexibility of the whole facility.
Freescoo + HCPV/T
Installation in the pilot at The Cyprus Institute
Freescoo, HCPV/T, LFC
as Energy Efficient Buildings (EeB) PPP Promising Technologies in 2018
Thank You for Your attention

I am thankful for the valuable contributions to:

Dr. F.M. Montagnino
Dr. P. Finocchiaro
Benefits for technology provider

Opportunities for TRL advancement and SME growth from participation in H2020 Innovation Actions

Sven Koehler
Executive Director

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This project has received funding from the European Union’s H2020 research and innovation programme under grant agreement N° 678407
1. TRL advancement?

2. EU project effect to Anerdgy as SME

3. Outlook

4. Summary
From the initial concept towards the realisation the project sites and buildings changed significantly. Our goal to propose most valuable new local energy technologies for Zero plus required quite some flexibility.
The planned TRL advancement of our product WindRail ended up by new developments and ground based iterations. Finally a new product called MRE-light has been realised instead of WindRail in order to serve the project as its best.

Learning: The TRL methodology does not reflect market feedback loops and resulting product redesigns.
### 2 Zero plus project effects to Anerdgy as SME

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Effect during the EU project</th>
<th>Medium term effect</th>
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<tbody>
<tr>
<td>Product development</td>
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<td>Market understanding different regions</td>
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<tr>
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<td>Pilot project realisation</td>
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<tr>
<td>Get market awareness</td>
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<tr>
<td>Improve MarCom materials</td>
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<tr>
<td>Get ready for market scale up</td>
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<tr>
<td>SME Revenue &amp; Amount of staff</td>
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</tbody>
</table>

The product development and pilot project realisation gave to us the highest impact. This will result medium term to higher revenue and amount of staff.
The roof edge system MRE is an important key technology to develop sustainable and economical flat roof concepts.

The guidebook can be found here.
1. The Zero plus project participation has Anerdgy helped to define our market offering.

2. The realisation of the pilot project and communication around has increased our credibility towards potential customers.

3. Financial wise we have invested more and time wise pretty much more than initially planned but we took this as out of ZP scope activities.

4. The ZP project participation has helped us to bring innovation to the market which otherwise would have been not possible.
Q&A
Submit your question!

Shabtai Isaac  M.N. Assimakopoulos  Kostas Gompakis  Salvatore Carlucci  Anna Laura Pisello  Sven Koehler